

METHOD AND SYSTEM FOR CONDITIONAL ACCESS APPLIED TO
PROTECTION OF CONTENT

DISCLOSURE

Technical field

This invention relates to the field of access control and is particularly applicable to a method and system for sending/receiving information, with access control through an MPEG2 broadcasting network. This 5 method is applicable to any multiplexed dataflow based on the use of packets or frames.

The invention is also related to a scrambling platform and a descrambling receiver designed for use with this method.

10 More specifically, the invention relates to an access control method and system controlling access to a broadcast digital dataflow previously scrambled by an encryption key CW transmitted in encrypted form in an ECM (Entitlement Control Message), including at least 15 one access control criterion CA controlling access to data in the flow. The transmitted data could be decrypted instantly during transfer or recorded as such in a receiving terminal.

20 State of prior art

It is of overriding importance for operators to protect data and services distributed on line, particularly through the Internet network, during the broadcasting phase and after broadcasting of data, so 25 as to guard against pirating of these data.

Figure 1 shows an overview of an access control system according to prior art in which a scrambling platform 2, usually arranged at the entry to the network, receives an unencrypted flow F_x and outputs an encrypted content F_{xs} to a receiving terminal 4. The platform 2 contains a generator 6 of scrambling and descrambling keys CW_i , a generator 8 of Entitlement Control Messages (ECM), and a generator 10 of Entitlement Management Messages (EMM). The receiving terminal 4 includes a descrambling module 12, a security processor 14 including a decryption module 16 of the control keys CW_i and a memory 18.

Before dataflows can be broadcast, the dataflows are scrambled by the scrambling platform 2 using keys CW_i . The descrambling keys CW_i are transmitted to the terminals 4 in encrypted form inside entitlement control messages (ECM) with at least one access control criterion CA, in order to enable descrambling of the content of the broadcast flows. After using a comparator 20 to check access criteria with rights previously transmitted to the terminals 4 in entitlement management messages (EMM) and registered in the memory 18, the descrambling keys CW_i are decrypted and then transmitted to the descrambling module 12.

The descrambling keys CW_i change regularly on crypto-periods CP_i (typically a few seconds) and are usually applied to the descrambler 12 by pairs $[CW_i, CW_{i+1}]$ where CW_i represents the descrambling key valid during the crypto-period CP_i , and CW_{i+1} represents the descrambling key valid for the crypto-period CP_{i+1} , so as to improve the global security of the system.

Each descrambling key to be used is referenced by a bit indicating the parity of i such that two descrambling keys, one even ECW and one odd OCW, are configured on the descrambler at each ECM change, before the crypto-period is effectively changed.

One known technique for protecting the content once it has been broadcast in a remote broadcasting context, consists of recording this content with the associated conditional access signal.

10 A first disadvantage of this solution is due to the fact that it makes it impossible to associate distinct access criteria for the:

- direct content viewing phase from the flow;
- the content recording phase; and

15 - the flow display phase from the locally recorded content.

A second disadvantage of this technique is due to the fact that the secret operating keys stored in a security processor and used for decryption of the ECMs 20 are regularly updated. In this case, the ECMs stored with the content are no longer valid and the content becomes unusable even if the client has acquired usage rights beyond this period.

A third disadvantage is related to synchronisation 25 aspects between the supply and operation of descrambling keys CW_i during use of a recorded content. In this case, the backward read function cannot be done simply because the anticipated value of the next descrambling key (representing the previous 30 descrambling key) is not provided in the ECM.

Another technique known in prior art to protect the content is to use a so-called DRM (Digital Right Management) solution.

This type of solution is based on:

- 5 - the use of certificates to set up a line of trust between the components of the system;
- encryption or pre-scrambling of the content using a private key algorithm;
- sending of this private key associated with 10 usage rights on line to form an encrypted license using an encryption algorithm using a public key of the client.

This solution is not adapted to the context of remote broadcasting wherein a backward channel is not used systematically. Furthermore, this type of solution cannot make access to the content dependent on the possession of rights registered indifferently by radio 15 or on line in a security processor.

The purpose of the invention is to overcome the 20 disadvantages of prior art described above using a method and a device using a scrambling method based on periodic changes of control words and assuring upwards compatibility with earlier conditional access systems.

25 Presentation of the invention

The invention relates to an access control method controlling access to a broadcast digital dataflow previously scrambled using an encryption key CW transmitted in an entitlement control message ECM also 30 including at least one access control criterion CA,

said digital data possibly being recorded as such in a receiving terminal or decrypted during transfer.

According to the invention, this method includes the following steps:

5 On transmission:

- generating an entitlement control message R-ECM_c for recording the content of the flow as a function of a recording key KR_c and at least one criterion CRR defining a right to the record,

10 - generating an entitlement control message P-ECM_c controlling access to play back the content of the recorded flow as a function of a playback key KP_c and at least one criterion CRP defining a right to play back, and

15 on reception:

- analysing the message R-ECM_c, and
- authorising the recording if the criterion CRR is verified, otherwise prohibit the recording,

20 - analysing the message P-ECM_c, and

- authorising the playback if the criterion CRP is verified, otherwise prohibit the playback.

According to a first variant embodiment of the method according to the invention, the keys CW, KR_c and KP_c are encrypted by a first service key K_s.

25 According to a second variant embodiment of the method according to the invention, the keys CW, KR_c and KP_c are encrypted by three different service keys, namely K_s, K_{SR} and K_{SP} respectively.

In a first embodiment, the sending phase includes
30 the following steps:

for each dataflow:

- breakdownning the scrambling period into a sequence of crypto-periods CP_i each defining a validity duration of an individual key CW_i , and at each crypto-period change,

5 - scrambling the content of the flow using the key CW_i , and memorise a value $p(i)$ representative of the parity of i ,

10 - calculating an entitlement control message $SC-ECM_i$ as a function of the previously defined encryption keys CW_{i-1} , CW_i , CW_{i+1} , the value $p(i)$ and the criterion CA_i , said message $SC-ECM_i$ being intended to transport access rights to a data segment S_i corresponding to at least two crypto-periods,

15 - encrypting the keys CW_{i-1} , CW_i , CW_{i+1} using the playback key KP_c ,

- encrypting the result of the encryption in the previous step using a second service key K' s,

- encrypting the result of the encryption in the previous step using the recording key KR_c .

20 In a second embodiment, the emission phase includes the following steps:

for each dataflow:

25 - breakdownning the scrambling period into a sequence of crypto-periods CP_i each defining a validity duration of an individual key CW_i , and at each change of crypto-period i ,

- scrambling the content of the flow using the key CW_i , and memorise a value $p(i)$ representative of the parity of i ,

30 - calculating an entitlement control message $SC-ECM_i$ as a function of the previously defined encryption

keys CW_{i-1} , CW_i , CW_{i+1} , the value $p(i)$ and the criterion CA_i , said message $SC-ECM_i$ being designed to carry access rights to a data segment S_i corresponding to at least two crypto-periods,

- 5 - encrypting the keys CW_{i-1}, CW_i, CW_{i+1} using a second service key K'_s ,
- encrypting the result of the encryption in the previous step using the playback key K_{Pc} ,
- encrypting the result of the encryption in the 10 previous step using the recording key K_{Rc} .

In both embodiments, the sending phase also includes the following steps:

- calculating the entitlement control message $ECM_i = f[(ECW_i, OCW_i, CA)]$ wherein ECW_i and OCW_i represent 15 the even and odd control words previously encrypted using a first service key K_s , respectively,
 $ECW_i = CW_i$ if i is even, otherwise $ECW_i = CW_{i+1}$;
 $OCW_i = CW_i$ if i is odd, otherwise $OCW_i = CW_{i+1}$;
- broadcasting parameters in the ECM signal,
- 20 identifying the ECM channels attached to the service broadcasting the content of messages ECM_i , $P-ECM_c$, $R-ECM_c$, $SC-ECM_i$,
- providing the ECM_i , $P-ECM_c$, $R-ECM_c$, $SC-ECM_i$ messages to the receiving terminal.

- 25 Two message dispatching modes ECM_i , $P-ECM_c$, $R-ECM_c$, $SC-ECM_i$ are possible. These messages may be broadcast either on the ECM channel associated with the content of segment S_i , or output partly to the receiving terminal from an Authorisation Server at the entry to 30 the network on request and as a function of the envisaged type of use of the content.

Thus, the R-ECM and/or P-ECM messages can be output to the receiving terminal on request from an Authorisation Server at the network entry if the recording and/or playback are expected.

5 According to the invention, the reception phase in which the flow is received directly includes the following steps:

- recovering the ECM channel from the ECM_i message, using the signal attached to the service broadcasting the dataflow, and at each change of i ,
- analysing the message ECM_i so as to recover the even control word OCW and the odd control word ECW, to descramble the content of the broadcast flow so as to obtain direct access to this content.

15 The reception phase includes the following steps, to record the received flow:

- recovering the ECM channel from the $P-ECM_c$, $R-ECM_c$, $SC-ECM_i$ messages, from the signal attached to the service broadcasting the content;
- analysing the $R-ECM_c$ message to verify record access criteria CRR
- memorising the recording key KR_c ;
- recovering the message $P-ECM_c$ and store it with the content; and
- 25 for each crypto-period i :
 - recovering the message $SC-ECM_i$,
 - decrypting the message $SC-ECM_i$ using the recording key KR_c , and
 - recording the decrypted message $SC-ECM_i$ with the content.

According to the invention, playback access to the recorded flow content is obtained according to the following steps:

- recovering the message P-ECM_c in the content and
5 analyse it to verify read access criteria CRP,
- memorising the playback key KP_c; and
- recovering the current SC-ECM_i message in the content;
- decrypting the SC-ECM_i message with the playback
10 key KP_c and verify access criteria,
- recovering the encrypted keys CW_{i-1}, CW_i, CW_{i+1} and
the value p(i) indicating the parity of i, and
- using the second key K's to decrypt said keys
depending on the read direction to deduce ECW and OCW
15 from them; then
- applying either ECW or OCW to descramble the content when playing back.

In another variant, access to play back the content of the flow is obtained according to the
20 following steps:

- recovering the message P-ECM_c in the content,
- analysing the message P-ECM_c to verify read
access criteria CRP,
- memorising KP_c, and
- recovering the current SC-ECM_i message in the content,
25
- decrypting the SC-ECM_i message with the second
service key K's and verify access criteria,
- recovering the encrypted keys CW_{i-1}, CW_i, CW_{i+1} and
30 the value p(i) indicating the parity of i, and

- using the second key K_{Rc} to decrypt said keys depending on the direction of read to deduce ECW and OCW; then

5 - applying either ECW or OCW to descramble the content.

Preferably, the reception phase also includes the following steps:

10 - generating a local key K_I from attributes contained in the message R-ECM and at least one parameter related to the identity of the receiving terminal,

- locally over-encrypting the content to be recorded with this key K_I.

15 - when playing back, regenerating the key K_I using attributes contained in the message P-ECM and at least one parameter related to the identity of the receiving terminal,

- decrypting the recorded content using the regenerated key K_I.

20 In one particular application of the method according to the invention, the broadcast digital data represent audiovisual programs.

The invention also relates to an access control system controlling access to a digital dataflow 25 including a scrambling platform including at least one generator of entitlement control messages ECM and at least one descrambling receiver provided with a security processor.

According to the invention, the scrambling 30 platform also includes:

- a generator of entitlement control messages R-
ECM_c when recording the content of the received flow
and a generator of entitlement control messages P-ECM_c
when playing back the content of a recorded flow, and
5 the descrambling receiver, includes:

- means of recovering the ECM channel from P-ECM_c,
R-ECM_c messages,
- means of decrypting the content of a received
flow to record it,
- 10 - means of decrypting the content of a recorded
flow to play it back.

Preferably, the descrambling receiver also
includes means of generating a local key K_i from
attributes contained in the R-ECM message and the
15 identity of the receiving terminal to locally
encrypt/decrypt the content of the received flow.

The invention also relates to a scrambling
platform including at least one generator of
entitlement control messages ECM controlling access to
20 a dataflow broadcast in scrambled form, a generator of
entitlement control messages R-ECM_c to control
recording the content of a received flow and a
generator of entitlement control messages P-ECM_c to
control playing back the content of a recorded flow.

25 The scrambling platform also includes:

- means of breaking down the scrambling period
into a sequence of crypto-periods CP_i each defining a
validity duration of an individual key CW_i,
- means of encrypting the content of the flow at
30 each change of the crypto-period i using the key CW_i,

- means of calculating an entitlement control message SC-ECM_i as a function of the keys CW_{i-1}, CW_i, CW_{i+1} corresponding to crypto-periods CP_i, CP_{i-1} and CP_{i+1} respectively, a parity parameter p(i) and the access 5 control criterion CA_i, said message SC-ECM_i being intended to carry access rights to a data segment S_i corresponding to at least two crypto-periods,

- means of encrypting the keys CW_{i-1}, CW_i, CW_{i+1} using a playback key KP_c,

10 - means of encrypting the encryption result in the previous step using a second service key K's,

- means of encrypting the result of the encryption in the previous step using a recording key KR_c.

The invention also relates to a descrambling 15 receiver of a dataflow broadcast in scrambled form using a scrambling key CW_i including a security processor wherein at least one recording key KR_c is memorised and that will be used to descramble record entitlement control messages R-ECM_c and at least one 20 playback key KP_c intended to descramble the playback entitlement control messages P-ECM_c.

According to the invention, this receiver includes:

- means of recovering the ECM channel from P-ECM_c 25 messages and R-ECM_c messages from the signal attached to the service broadcasting the content;

- means of decrypting the message R-ECM_c using the recording key KR_c to verify the right to record the content of a received flow,

- means of decrypting the message P- ECM_c using the playback key KP_c to verify the right to play back the content of a recorded flow.

Preferably, the receiver according to the invention also includes means of generating a key K_r from the identify of the receiver to locally encrypt and decrypt the content of the received flow.

In one preferred embodiment of the invention, the security processor is a smart card.

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Brief description of the drawings

Other characteristics and advantages of the invention will become clear from the following description, given as a non-limitative example with reference to the appended figures wherein:

- figure 1 described above shows a block diagram of an access control system according to prior art,
- figure 2 is a block diagram showing the scrambling phase of flows to be broadcast by an access control system according to the invention,
- figure 3 diagrammatically shows the access control method controlling recording of a dataflow according to the invention,
- figure 4 diagrammatically shows the access control method controlling access to play back the recorded dataflow according to the invention.

Detailed presentation of particular embodiments

The following description will be given in the framework of a particular application wherein broadcast

flows represent audiovisual programs requiring an access right.

In this application, the process is based on broadcasting the content through a structure of 5 multiplexed packets the form of which is given in appendix 1.

The signal of the program broadcasting the content includes a precise description indicating multiplex channels by a Packet Identifier used on reception of 10 the content and the nature of the data transmitted in each channel (sound, video or other component).

This signal includes a conditional access descriptor "CA_descriptor" indicating the presence and location of channels carrying ECMs. This descriptor is 15 associated either with the global level of the program or with each declaration of a component channel.

The format of this descriptor is standard in the case of a MPEG2 ISO13818-1 broadcast represented in appendix 2.

20 Private data "private_data_byte" for the method described are described in appendix 3 for one embodiment.

They have a suffix XID in the header of ECMs and are used as a discriminator to distinguish between 25 different ECMs transported on the same packet channel.

The following combinations are possible when part of the ECM_i , P- ECM_c , R- ECM_c , SC- ECM_i channels is missing:

- channel ECM_i missing: no immediate display;
- 30 • channel R- ECM_c missing: recording prohibited or if the receiving terminal has an operational return

channel, connect to a network entry Authorisation Server delivering the R-ECM_c message necessary to record the content;

• channel P-ECM_c missing: read prohibited or if the 5 receiving terminal has an operational return channel, connect to a network entry Authorisation Server outputting the P-ECM_c message necessary to read the recorded content;

• channel SC-ECM_i missing: R-ECM_i and P-ECM_i are 10 then missing and recording is not authorised.

The payload may or may not be encrypted by the scrambling platform 2 depending on the nature of transmitted data (signal or audio or sound component) and the value of the "Scrambling Control" field is 15 equal to one of the following values:

- the packet is not scrambled,
- the packet is scrambled using the even control word ECW,
- the packet is scrambled using the odd control 20 word OCW.

Figure 2 diagrammatically shows the scrambling phase of flows to be broadcast by an access control system according to the invention.

Step 30 consists of generating a recording secret 25 access control key KR_c controlling access to recording and a secret playback access control key KP_c controlling access to play back.

Step 32 consists of breaking down the scrambling period for each dataflow into a sequence of crypto- 30 periods CP_i each defining a validity duration of an individual key CW_i. The packets thus formed are then

applied to a scrambling and multiplexing module 34 that receives an ECM_i message in parallel containing the descrambling keys CW_i , CW_{i+1} controlling entitlement to the content of the flow and at least one access criterion CA_i , a message $SC-ECM_i$ containing the descrambling keys CW_{i-1} , CW_i , CW_{i+1} controlling entitlement to the content of a data segment S_i corresponding to at least two crypto-periods, a message $R-ECM_c$ containing the recording key KR_c controlling recording of the content of the segment S_i and at least one criterion CRR defining a right to record this content, and a message $P-ECM_c$ containing the playback key KP_c controlling access to play back the content of the recorded segment S_i and at least one criterion CRP controlling access to play back the content of this segment.

Before this, in step 36, the descrambling keys CW_i , CW_{i+1} are encrypted using a first secret service key K_s extracted from a smart card 38 and in step 40, the descrambling keys CW_{i-1} , CW_i , CW_{i+1} are encrypted successively by the recording key KR_c then by the playback key KP_c in step 42, the key KP_c is encrypted by a second service key K'_s extracted from the smart card 38, and in step 44 the key KR_c is encrypted by the second service key K'_s .

The messages ECM_i , $R-ECM_i$, $P-ECM_i$ and $SC-ECM_i$ to be broadcast are then applied to the scrambling and multiplexing module 34 to be multiplexed with the data packet and transmitted to the receiving terminal.

Note that step 42 is equivalent to over-encryption of control words CW_{i-1} , CW_i , CW_{i+1} in sequence using the

playback key K_{Pc} , the second service key K'_s , and then the recording key K_{Rc} .

In one variant embodiment, this over-encryption of control words CW_{i-1} , CW_i , CW_{i+1} is done in sequence using 5 the key K'_s , using the playback key K_{Pc} , and then using the key K_{Rc} .

Figure 3 diagrammatically shows the reception and descrambling phase of a broadcast content in order to record it.

10 Step 50 consists of finding the ECM channels present in the P- ECM_c , R- ECM_c , SC- ECM_i messages in the signal attached to the service broadcasting the content.

Step 51 is only carried out if the R- ECM_c message 15 is missing from the broadcast. Another condition is that the receiving terminal should have a two-directional switching device. Step 51 consists of connecting to an Authorisation Server, declining the identifier of the content to be recorded and the 20 identity of the client terminal. According to known criteria of the Authorisation Server, this server outputs the R- ECM_c necessary to record the content, on line.

In step 52, the R- ECM_c message is presented to the 25 security processor that checks recording access criteria and then memorises the key K_{Rc} . Step 52 is only done if the P- ECM_c message is broadcast.

In step 54, the message P- ECM_c is recovered and is then stored unchanged in the header of the content 30 storage file.

In step 56, the message $SC-ECM_i$ is recovered for each crypto-period i and is then presented to the security processor that decrypts it using the key K_{Rc} to recover a decrypted message $SC-ECM_i$ that is then 5 recorded with the multiplex packets forming the content.

In one variant embodiment, these multiplex packets are encrypted locally (step 58) using a key K_i generated in step 60 from attributes contained in the 10 message $K-EMC_c$ and a parameter related to the identity of the decoder. By way of example, this parameter may be the serial number of the decoder, the unique identifier (UA) of the smart card, or the serial number of a hard disk installed in the receiving terminal.

15 Figure 4 diagrammatically shows the descrambling phase of a content recorded in a recording support 60 in order to read it.

Step 62 consists of searching for the message $P-ECM_c$ in the header of the file containing the dataflow. 20 The next step 63 is only done if the message $P-ECM_c$ is missing from the header of the containing file. Another condition is that the terminal should have a two-directional communication device.

Step 63 consists of connecting to an Authorisation 25 Server, and stating the identifier of the content to be read and the identity of the client terminal. According to known criteria of the Authorisation Server, this server puts $P-ECM_c$ necessary to read the content on line.

30 In step 64, the found message $P-ECM_c$ is presented to the security processor that checks read access

criteria, and then memorises the playback key K_{Pc} in the smart card 38.

If the content has previously been scrambled locally in accordance with step 58 described above, the 5 local identity key K_I is then calculated from identity information of the receiving terminal (step 68), and the multiplex of the content is decrypted for each crypto-period i while reading.. using the key K_I (step 70).

10 In one preferred embodiment of the invention, while playing back, the key K_I is regenerated from attributes contained in the message P-ECM and at least one parameter related to the identity of the receiving terminal, and is used to decrypt the recorded content.

15 In step 72, the current message $SC-ECM_i$ is recovered and presented to the security processor (step 74) that decrypts it with the key K_{Pc} to check read access criteria CRP and to recover the control words CW_{i-1} , CW_i , CW_{i+1} and the parity of i . One of the 20 descrambling keys ECW or OCW is supplied to the descrambler to descramble the data segment S_i , depending on the required reading direction.

If the segment S_i is to be displayed directly, the method according to the invention can be used to find 25 the ECM channel and the index of ECM_i values in the signal attached to the service broadcasting the content at each change of i and to apply ECM_i to the security processor to recover even and odd control words OCW, ECW and to apply them to the descrambler 80.